Exploiting the Acoustic Camera Obscura Effect in Order to Improve Directional Specificity of Passive SoNAR

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Introduction

One of the limitations of submarine warfare is the inability to determine with precision the bearing of a passively detected contact. One tried and true method for achieving this is what is know as a towed array. The use of a towed array allows for the sounds detected by the primary array and the towed array to be compared, much as a human compares what is heard through their left and right ears in order to determine from which direction a sound originated.

Torpedoes are electrically powered and generate a great deal of noise. Their range is limited. As such, the maximum range of a torpedo and the noise it produces impose one limitation and an inability to get a precise bearing fix through a passive sonar from a great distance is another. In theory, if a slow-moving, silent torpedo with unlimited range could be fielded, a sufficiently precise bearing fix would allow for such a torpedo to arrive in sufficient proximity to the target that its active tracking system would be able to achieve a lock without providing undue early warning to the enemy sub.

In addition to using a towed array, both a towed and primary array may be augmented in the following way in order to ascertain bearing to a higher degree of precision. The method may be used in isolation without the towed array, which produces noise during extension and retraction and increases the profile of the attack sub.

Abstract

A mechanism for refining bearing estimates from passive SoNAR arrays may be constructed by adding to the geometric facets of the array a double-membrane consisting of an acoustically conductive elastomer. Between the two membranes would be an atmospheric vacuum and a small gap of perhaps a millimeter. Once a passive SoNAR contact is established, this mechanism would be activated. When activated, the servo-mechanical mechanism which holds the two membranes together would release, creating a gap which would block sound, given the atmospheric vacuum condition. An actuator would depress the outer membrane to cause it to have contact along a narrow, linear area through which acoustic energy may be permitted to enter. This would exploit an effect which may be termed the *acoustic camera obscura effect.*

By permitting sound only through a narrow area and then slowly adjusting the physical area of contact between the two layers, the deviation in the angular momentum of the acoustic energy can be used to infer its angular momentum as it travels through the ocean more precisely.

When combined with computer-based analysis of the data collected, a precise bearing fix could be calculated rapidly by analyzing the dynamic of strike position on the detector versus which zone of the membrane was permitting sound to pass through. The acoustically permissive “slit” would both focus and alter the angular momentum of sound in a way which allows for precise measurement of angular momentum, well beyond what is possible through the use of geometric facets, alone.

Conclusion

This upgrade could be implemented at comparatively low cost and would open the door to novel ASW tactics which would allow for successful sub-on-sub attacks without betraying the position of our own attack submarines.